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truly marvelous was the grasp this man displayed in so many varied subjects!

Now who has ever attempted to apply his knowledge to fields outside his own immediate one that has not felt this same irresistible, impelling, burning desire to know all that has been done before him in the new country he is about to explore? Haven't we each one of us found that with such an all-conquering impetus back of us the most complex mathematics or the most abstruse subject teems with a new and living interest? What was irksome before has now become a pleasure! And if there is one of you who for lack of excursions into such green pastures has not had new and invigorating blood course through his veins and has not been given a glimpse of a higher, truer and more ennobling vision of life, he has missed the greatest pleasure and the highest compensation open to the research worker!

Do you know of a school of thought that has prevailed for any length of time without resistance to that most subtle and, therefore, most dangerous of all insidious modes of attack, viz., the one coming from within its own fold of devotees, due to the pernicious habit of in-breeding? Is there any greater danger than that which besets a university which fills its chairs repeatedly from among its own graduates? We all know of the fallacy of the brilliant professor who thinks his ideas can be made to continue longest by surrounding himself with assistants drawn, if not entirely, at least chiefly, from among his own disciples. Will he not surely find, as Maxwell put it, that his "system has closed him in before he is forty" because he has forgotten the essential element to prevent crystallization—the importation of fresh blood and the introduction of new ideas?

If you agree with the speaker thus far, may not similar occurrences be recorded of our societies, because of the suicidal policy

of a particular class of members who are apt to believe that the best result can be reached by increasing their representation, and thus by their majority vote be able to dictate and control the general policy of the society to which they belong? Is it wise organization for membership in any deliberative body to be so constituted as to make it possible for the act of the assembly to be unduly influenced by one set of investigators? Is there not here subject for careful thought—a source of degeneracy due to the in-breeding in societies to be equally guarded against? Joseph Henry truly said: "Votes in science should not be counted, but *weighed*!"

This then is my specific plea: a broader conception and a more scientific representation of the subjects of physical research. Could we not make the attempt certainly once a year to devote most of our time and attention to some of the greater aspects of our work and take stock, so to speak, of our achievements, and of their possible applications?

L. A. BAUER

REPORT OF THE COMMITTEE OF THE AMERICAN CHEMICAL SOCIETY APPOINTED TO COOPERATE WITH THE NATIONAL CONSERVATION COMMISSION

In May, 1908, a meeting of the governors of the different states was held at the White House in Washington to consider the conservation of our rapidly wasting natural resources. Following this meeting, a commission was appointed by the president of the United States to investigate the subject, and the principal scientific societies of the United States were invited to cooperate with it. The committee of the American Chemical Society, appointed in response to this invitation, now has the honor to submit the following preliminary report.

On December 8, 9 and 10 the National Conservation Commission met in Washington in joint conference with the delegates of

other organizations and the governors of more than twenty states. The commission, in its elaborate investigations, had, so to speak, taken stock of our natural resources, and its report, therefore, was essentially statistical in character. It had estimated the magnitude of each particular resource, and had studied the rate of consumption of such substances as lumber, coal, iron, etc. It discussed the waste of the land by preventable erosion, and its effects not only upon agriculture but also in reducing the navigability of streams. Questions like these were treated at considerable length, and their general character is all that need be mentioned just here. The data of the commission were mainly classified under four headings, namely, minerals, forests, lands and waters, and under each one the evils to be remedied were pointed out with all the emphasis and clearness which the statistical method of investigation made possible. The commission cleared the ground for study into the prevention or limitation of future waste; and the problem of conservation can now be taken up in a more intelligent manner than has been possible hitherto. We now know better than ever before what the evils and dangers really are; the next step is to discover remedies, and then, finally, to apply them. The public attention has been aroused; the people of the country are awakening to the necessity of greater prudence and economy in the use of our resources, and definite lines of action can now be laid down with a reasonable probability that they will be followed. Fortunately the reports of the commission are neither sensational nor unduly pessimistic; the results of their conferences are presented seriously, and in such a manner as to compel consideration; they are therefore all the more likely to produce permanent effects of great benefit to the American people. The utterances of the mere alarmist rarely carry conviction; but disclosures like these made by the Conservation Commission can not be disregarded.

Up to the present moment chemistry has had little to do with the investigations of the commission. Henceforward the chemist must

be called upon in many ways, for the waste of resources is often preventable by chemical agencies. Chemistry has already done enough to prove its potency, and its influence is felt in every branch of industry. Adopting the classification of the commission, we shall find the chemist active under every heading. Under minerals, we must note that metallurgy is essentially a group of chemical processes by which the metals are separated from the ores; a separation which may be either wasteful or economical. Within recent years, within the memory of members of this society, the available wealth of the world in metals has been enormously increased. By the cyanide process for extracting gold, ores are now profitably worked which were formerly worthless, and at the same time the demand for mercury has been decreased. The Bessemer process for steel making, now also modified for use in copper smelting, is purely chemical; and its later modification, the Gilchrist-Thomas process, applies similar principles to phosphatic ores, which were previously of little value. Furthermore, in the last-named process, phosphatic slag is produced, which is useful as a fertilizer and helps to relieve the drain upon our rapidly wasting supplies of phosphate rock. Chemists are now studying, with much success, the problem of preventing corrosion in iron, a research which will prolong the life of iron structures and thereby reduce the waste of ore. The use of coal slack by briquetting methods is largely based upon chemical investigations; the salvage of by-products from coke ovens, such as tar and ammonia, is wholly due to chemical research; coal is further economized by the study of boiler waters and the consequent prevention of boiler scale. Even inferior coals, lignites, are now converted into what is known as producer gas, and so are transformed into the best kind of fuel. Petroleum is refined by chemical means, and every fraction of it is saved, either as illuminating oil, as gasoline, as a lubricant, as vaseline, or as paraffin. These are all notable achievements, but greater are yet to come. Enormous quantities of valuable substances are thrown into

the atmosphere in fumes from smelters, which should, and probably can be, partly saved. Electro-chemistry is rapidly developing a large group of new industries, making such metals as aluminum, magnesium and calcium available for use, and it is reaching out into other fields of electrometallurgy in which electric heat, generated by water power, will be used for smelting other metals, thereby reducing the consumption of coal.

In forestry also, the influence of the chemist is distinctly felt. The sprays, used for destroying noxious insects, are chemical preparations. The manufacture of wood alcohol is a chemical process, which may be either wasteful or economical. Turpentine is now produced wastefully, but the waste can be diminished by careful refining, and furthermore, the chemist can aid in discovering substitutes for it. Substitutes for tan bark are also to be sought for by means of chemical investigations. Another distinctively chemical operation is the preparation of wood pulp for paper making, a process which is now wasteful in the highest degree. It is estimated that for every ton of pulp now made by the sulphite process more than a ton of waste material is allowed to drain away into our streams. How to make this material useful is a chemical problem, and so also, in great part, is the investigation of other, now useless fibers, which may replace the more valuable wood. The preservation of wood from decay is still another art in which chemistry is predominant.

In preserving the fertility of our land, chemistry has an important part to play. Our knowledge of fertilizers, of the food on which crops can thrive, is entirely chemical so far as accuracy is concerned, and must be applied in accordance with chemical principles. A fertilizer which is useless, and therefore wasted on one soil, may be needed on another. Certain fertilizers, like the Stassfurt salts, Peruvian guano, the Chilean nitrates, and phosphate rock are limited in quantity, and their future exhaustion must be considered now. What shall replace them in the future? Already processes have been devised for fixing

the nitrogen of the atmosphere and rendering it available for plant food. Saltpeter and other nitrates can be and long have been made from waste materials such as old mortar and animal refuse. The phosphatic slags have been mentioned in connection with metallurgical processes. These sources of fertility are important, but greater still is the source found in our municipal sewage. The problem of its salvage has been worked out in some localities, but in the United States the people are only beginning to be aroused to its importance. Enormous masses of material, easily available for fertilizing purposes, now drain into our rivers or directly into the sea. Another question, now under investigation, is the possibility of using our common feldspathic rocks in fine powder, to replace the potassium withdrawn by plants from the soil. The relations between the chemical composition of water and the conservation of natural resources are of intimate and fundamental importance and some of them have been mentioned under other headings. The rate at which the land surface of the United States is being transported to tide water has recently been estimated by means of chemical analyses of river water coupled with determinations of stream flow, and the results of the computations will doubtless assist considerably in studying soil erosion and the impoverishment of agricultural lands. In steam making the chemical quality of the water supply is an appreciable factor in fuel consumption, a subject to which reference has already been made. The scale that forms on the boiler shell and tubes, when water containing incrustants is used, is a poor conductor of heat and, consequently, causes increased expense for fuel. By detailed study of the chemical composition of available boiler waters, it is possible to select a supply having a minimum amount of incrusting, corrosive and foaming constituents, thereby effecting appreciable economy in fuel. Chemical investigation of methods for purifying water supplies, not only for boilers but for paper manufacture, soap-making, and other great water-consuming industries, will enable man-

ufacturers to make new and greater saving in many raw materials other than fuel.

Stream pollution by industrial refuse and by sewage is a source of enormous waste in our natural resources. The subject has been for many years a field of research for industrial, sanitary and biological chemists in the United States, and their investigations have resulted in the improvement of manufacturing processes, the utilization of wastes, the purification of sewage, and the protection of domestic water supplies. When the presence of deleterious substances in our river and lake waters has caused loss of fish life and the destruction of oyster beds, the chemist and the biologist have detected the harmful ingredients and have suggested methods for their removal. River silt, an important source of detriment to navigation, is also estimated by the chemist. It has been fully demonstrated that the prevention of stream pollution lies not alone through injunctions and other legal proscriptions but also in using waste materials or, when that is not possible, in rendering them harmless. The chemist has much to do in protecting and preserving the quality of our water supply. Upon that, in very great measure, depends the preservation of our highest resource, human life. Polluted waters distribute typhoid fever and other dangerous diseases, and so cause losses which should be, and really are, preventable.

The foregoing illustrations are enough to show, for present purposes, the intimate connection between chemistry and the study of conservation. They also bring out the fact that the classification adopted by the national commission, although admirable for statistical research, is not final, and that it needs to be supplemented by a different subdivision of the data. The facts to be investigated often fall under more than one heading of the classification, and actually interlock in every conceivable manner. To operate a placer mine, for example, abundant water is needed, while a deep mine requires timber for its shafts and levels. In building and occupying a house one covers land, uses lumber, brick, stone, and iron, introduces water supply, and burns fuel.

In short, every phase of the conservation question affects the interests of everybody. If the investigation of our natural resources is to be made effective, it must be applied to individual industries, and in order to do that another scheme of classification would seem to be necessary. Such a scheme we venture to outline, but very briefly.

At the outset the problem can be divided into two parts, one relating to sources of energy, the other to material substances. The two are not really separable, but may advantageously be considered separately.

In the first place, the energy available for industrial uses may be classified under three heads, as follows: First, inexhaustible energy, such as solar radiation, wind power, tidal power and, with certain limitations, the power furnished by flowing streams. Second, reproducible or renewable energy, like the power supplied by horses and other domestic animals. Wood, regarded as fuel, also falls under this heading, for forests can be artificially grown. Third, the exhaustible energy represented by mineral fuel, like natural gas, petroleum, and coal, which, once used, is gone forever. Under this classification the practical problems are, to economize the exhaustible energy, to encourage the development of renewable energy, and to discover new methods of using the inexhaustible energy.

Exactly the same classification applies to material substances. Some, like sea salt, limestone and clay are, humanly speaking, inexhaustible. Agricultural and forest products are reproducible, some of them year by year. The metallic ores and such useful minerals as phosphate rock are, however, exhaustible, and need to be conserved.

With the aid of this very simple classification it becomes possible to analyze a specific industrial problem in such a manner as to make evident its factors of waste or economy. For example, sea salt is inexhaustible, and may be extracted by solar evaporation, which is a use of inexhaustible energy. Agricultural products are renewable, and their production chiefly requires the renewable energy of men and animals. But the smelting of

metallic ores, as now conducted, involves the use of exhaustible material both as ore and as fuel.

In most industries, however, the two sets of considerations are combined. Portland cement, for example, is made from inexhaustible substances, but is burned with exhaustible fuel. The latter factor in the industry, therefore, is the one to be carefully considered, while the first factor is negligible. Taking industry by industry we shall find that this condition of affairs is general, and that each one must be studied by itself with reference to its inexhaustible, reproducible and exhaustible elements. In doing this a clear notion can be obtained as to the real needs of a given industry, and our attention can then be concentrated upon those features of it which particularly demand economy. We shall be able to locate evils with greater accuracy; to diagnose the industrial diseases, so to speak, and then to look intelligently for remedies. Many of the remedies must be sought for along chemical lines of research, which will develop economical processes of manufacture, utilize materials that are now wasted, or substitute cheap for costly substances. Cheap and costly, however, are words which need qualification. A substance or a process which is cheap to-day may be in reality wasteful with a temporary reduction in price at the cost of some permanent economy. For our purposes the two words imply a deeper discrimination than is carried by their ordinary use. Temporary efficiency and cheapness are to be discountenanced, while permanent economy for the benefit, not only of the nation but of the whole human race, is to be encouraged. This principle is sound, but its practical applications will involve many difficulties, and develop many conflicts with special interests. Like all ideals it can not be realized absolutely, but it represents a standard of action towards which we must move, even though the ultimate goal of perfection may never be attained. Evils can be mitigated, although they may not be entirely removed.

The American Chemical Society now num-

bers more than four thousand members, scattered through all the states and territories of the union and represented in every one of our great productive industries. These chemists are at the same time progressive and conservative in their work, for they are both discovering new utilities and protecting old ones from loss. We believe that every member of the organization is necessarily in sympathy with the great forward movement for economy, and that in our society the National Conservation Commission will find a most powerful and willing ally.

F. W. CLARKE,
H. W. WILEY,
C. H. HERTY,
S. W. PARR,
R. B. DOLE

SCIENTIFIC NOTES AND NEWS

THE Royal Academy of Stockholm has presented Mr. Thomas A. Edison with its Adelskiöld gold medal for his inventions in connection with the phonograph and the incandescent light. This medal is conferred once in ten years.

PROFESSOR CLEVELAND ABBE, of the U. S. Weather Bureau, has been elected an honorary member of the Royal Meteorological Society.

THE Alumni Association of Columbia College and the School of Mines gave a dinner to Dean J. H. Van Amringe, professor of mathematics in Columbia University, on April 3, to celebrate his birthday and a half century of teaching at Columbia College. A loving cup was presented to him.

IT is announced that President Taft has requested Surgeon General Wyman to draw up a tentative plan for the consolidation under one bureau of the agencies exercised by the federal government for the preservation of the public health.

M. JUNGFLEISCH has been elected a member of the Paris Academy of Sciences in the section of chemistry as successor to the late M. Ditte.

MR. CHARLES S. SHERRINGTON, professor of physiology in Liverpool University and Mr. William H. Maw, editor of *Engineering*, are